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Experiment Station

LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY. 2. PRINCESS COAL RESERVE DISTRICT.

Open-pit or strip-mining—primarily for coal—has expanded rapidly in eastern Kentucky during the past 15 years. Information about the amount, location, and general characteristics of the disturbed areas is necessary for appraising the economic impacts and overall effects of strip-mining in that section of the state, for planning reclamation programs, and for determining research needs and priorities. To obtain reliable estimates of the acreage disturbed both by the mining itself and by the associated coal-haul roads, and to provide relevant information about the disturbed areas, a survey was made. The survey was based on aerial photographs of all stripped areas as of October 1964.

The survey was broken down in accordance with the six subdivisions or coal-reserve districts delineated by the U.S. Geological Survey,[1] and a separate report on each district is planned. The first report[2] has been published. This is the second in the series.

The method used in our survey was a modification of forest-survey procedure. A 3-by-6-inch transparent template with 25 dots per square inch was positioned over the center of each photograph. Areas on the photographs that appeared to be stripped land or coal-haul roads were examined stereoscopically to determine important characteristics, and the amount of area in various categories was estimated by dot counts.

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1 Huddle, J. W., F. J. Lyons, H. L. Smith, and J. C. Ferm. COAL RESERVES OF EASTERN KENTUCKY. U.S. Geol. Survey Bull. 1120, 147 pp., 1963.

2 Plass, William T. LAND DISTURBANCES FROM STRIP-MINING IN EASTERN KENTUCKY. 1. UPPER CUMBERLAND COAL RESERVE DISTRICT. U.S. Forest Serv. Res. Note NE-52. 8 pp., illus. NE. Forest Exp. Sta., Upper Darby, Pa. 1966.

The Princess Coal Reserve District

The Princess is the most northerly coal reserve district. It includes all of Boyd, Carter, Greenup, and Lawrence Counties (fig. 1). Although it is one of the least important in coal production, it ranks high as a source of refractory clays. Most of the clay is recovered by open-pit mining.

Figure 1.—Geographic and geologic features of the Princess Coal Reserve District.

Coal has been mined in the District for about 140 years. The first production came from mines in Greenup County in 1824. Between 1824 and 1955, the total production by counties was as follows: Boyd County, 13 million tons; Carter County, 12 million tons; Lawrence County, 3 million tons; and Greenup County, 2 million tons.[2]

According to Merz,[3] strip-mining for coal began in Boyd County in the early 1940's. He reported that 707 acres had been disturbed by stripping up to 1949, and that all the stripping was then less than 5 years old.

In 1963, the Kentucky Department of Mines and Minerals[4] reported only two active coal strip-mines in the District: one in Boyd County and one in Lawrence County. Production was 49,000 tons, whereas underground mines produced 63,000 tons.

District coal reserves (measured, indicated, and inferred) are estimated to be 2 billion tons.[2] Ten percent of this is in beds over 42 inches thick and 30 percent is in beds 28 to 42 inches thick. Eighty-five percent of the reserves are located in Boyd, Carter, and Lawrence Counties. There is no estimate of the amount that can be recovered by strip-mining.

Clays have been mined in the district at least since the turn of the century. In comparison to coal, yearly production is small, and it comes from many small mines. Mandt[4] reported that state-wide production from the 10 clay-producing counties was 614,000 tons in 1963. He listed 25 active mines or clay pits in Carter and Greenup Counties.

Clay reserves are assumed to be extensive. However, there are reports that the most accessible reserves of flint clay are diminishing.

Forest Cover

The percentage of forest cover in the Princess Reserve District varies from 56 percent in Boyd County to 82 percent in Lawrence County.[5] There is no distinctive pattern of land use: agricultural, road, and urban developments occur in the valleys, on the ridges, and on the slopes. Forests occur immediately below and adjoining 76 percent of the stripping.

In Boyd, Carter, and Greenup Counties 40 to 50 percent of the stands are of sawtimber size, but in Lawrence County the proportion drops to 23 percent. About 15 percent of the commercial forests are classified as

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[3] Merz, R. W. CHARACTER AND EXTENT OF LAND STRIPPED FOR COAL IN KENTUCKY. Ky. Agr. Exp. Sta. Circ. 66, 27 pp., 1949.

[4] Mandt, A. H. ANNUAL REPORT. Ky. Dep. Mines and Minerals, 166 pp.

[5] Unpublished preliminary report, BASIC FOREST RESOURCE STATISTICS, NORTHERN CUMBERLAND UNIT, KENTUCKY, 1963. U.S. Forest Serv. and Ky. Dep. Natural Resources, 1965.

southern pine or southern pine-hardwood types, and 45 percent are classified as oak-hickory.

Physiography and Geology

In general, the topography of the District is not so rugged as in other parts of eastern Kentucky. The local relief seldom exceeds 600 feet, but the landscape is highly dissected. Although the valleys are generally narrow and winding, some major streams have wide alluvial flood plains. The principal drainages are Tygarts Creek, the Little Sandy River, and the Big Sandy River.

Four geologic formations are exposed at the surface in varying degrees. From top to bottom or youngest to oldest these are: the Conemaugh formation, the Breathitt formation, the Lee formation, and the Mississippian rocks. The commercial clay deposits are found in the Lee formation and the coal deposits are in the Breathitt formation. On the basis of the surface geology, we defined and delineated the following five zones: the Mississippian rocks to Lee formation transition zone; the Lee formation to Breathitt formation transition zone; the Breathitt formation; the Breathitt formation to Conemaugh formation transition zone; and the Conemaugh formation. Transition-zone nomenclature was adopted wherever two formations are exposed over a substantial area in about equal proportions.

The different kinds and intensities of open-pit mining are distinctly associated with certain zones. Most of the mining for clay occurs in the Mississippian to Lee and the Lee to Breathitt transition zones. These zones represent about 45 percent of the land area. Both are located in the western part of the District (fig. 1). Stripping for coal, although centered in the Breathitt formation, also occurs in the Breathitt to Conemaugh transition zone. Together, these two geologic zones represent another 45 percent of the land area. The remaining 10 percent of the area, underlain by the Conemaugh formation, has very limited coal reserves and has not been disturbed by strip-mining.

The Allegheny synclinorium, a southeasterly plunging down-warp, is the largest and most important structural feature in the District. This causes a regional dip in Carter and Greenup Counties from northwest to southeast of about 50 feet per mile. In southern Carter County this may increase locally to 200 feet per mile. Erosion has exposed the coal and clay deposits in the Breathitt and Lee formations at several locations.

The Olive Hill clay bed, a major producer in the District, occurs near the bottom of the Lee formation, generally less than 30 feet above the

underlying Mississippian rocks. In the western part of the District this bed is exposed high on the hills, where the clay is readily removed by strip-mining.

In the eastern part of the District the southeasterly dipping Lee formation disappears below grade and is replaced by the coal-bearing Breathitt formation. The latter is 475 to 800 feet thick and has 13 coal seams that have some commercial value. Of these only three have been strip-mined. Further to the east the Breathitt formation with its associated coal seams dips below the Conemaugh formation. Here underground mining becomes necessary to remove the coal.

Distribution of Stripped Areas

As of 1964, 4,761 acres—0.56 percent of the 855,000 acres in the District—had been disturbed by strip- and auger-mining for clay and coal (excluding coal-haul roads). Eighty percent (3,809 acres) was attributed to coal mining and 20 percent (952 acres) to clay mining.

Of the four counties, Boyd County had the greatest amount of stripping in terms of both acres and percentage of total land area: 2,412 acres or 2.37 percent (table 1). All of this was attributed to coal mining. Lawrence County had the least disturbance—125 acres or 0.05 percent of its land area.

For that part of the land surface in the District that is underlain by the coal-producing Breathitt formation, stripping disturbance totaled 2,998 acres or 1.03 percent of the area. The Mississippian to Lee transition zone, a clay producer, ranked second in disturbed acreage, and the coal-producing Breathitt to Conemaugh transition zone a close third.

Most of the disturbance can be attributed to mining the Olive Hill clay bed and the Princess #7 coal seam. Of minor importance are the Richardson or Princess #5 seam in Carter County and the Princess #8 seam in Lawrence County.

Physical Characteristics of Disturbed Areas

Coal and clay are removed by two basic types of mining: contour- or rim-stripping, and area-stripping. About 90 percent of all disturbance in this District has resulted from contour-stripping on mountain slopes. For this type of mining, 13 percent of the disturbed area was on or above the highwalls; 45 percent was in pits, inslopes, or leveled or unleveled benches above the outslopes; and 42 percent was on outslopes. Of the 2,000 acres of outslope, 80 acres, or 4 percent, were in slides or slumps.

Table 1.—*Area disturbed by open-pit mining in the Princess Coal Reserve District, by counties and zones, exclusive of haul-roads*

County	Mississippian to Lee transition zone	Lee to Breathitt zone	Breathitt zone	Breathitt to Conemaugh transition zone	Conemaugh zone	All zones	Percent of land area disturbed
	Acres	*Acres*	*Acres*	*Acres*	*Acres*	*Acres*	*Percent*
Boyd	—	—	1,823	589	—	2,412	2.37
Carter	446	59	742	110	—	1,357	.53
Greenup	423	31	413	—	—	867	.39
Lawrence	—	—	20	105	—	125	.05
Total	869	90	2,998	804	—	4,761	0.56
Percent of land area disturbed	0.46	0.05	1.03	0.80	0	0.56	—

Area-stripping accounted for 505 acres—almost exactly 10 percent of all disturbance. All of this occurred on hill tops where the overburden was shallow and several successive parallel cuts could be made. In the area-stripping, 6 percent of the disturbance was on or above the highwalls; 55 percent was in pits, inslopes, or leveled or unleveled benches above the outslopes; and 39 percent was on outslopes. Four percent of the 200 acres of outslopes were in slides or slumps.

Leveling of the disturbed area is a much more common practice in clay mining than in coal mining. Seventy-nine percent of all clay pits were leveled and another 17 percent partially leveled. For the coal operations, 32 percent were leveled and 7 percent partially leveled.

A total of 250 acres were disturbed by haul-roads. This, plus the 4,761 acres disturbed by the mining itself, make a grand total of 5,011 acres disturbed by all phases of the mining operations.

From field measurements, the haul-roads in this District were found to average 31 feet in width from the top of the cut bank to the lower edge of the fill bank. Therefore, on the average, each mile of road disturbed 3.8 acres. To determine the mileage of haul-roads, we computed from our dot count the acreage disturbed by roads. Then we divided this figure by the acreage disturbed per mile of road. By this method we estimated that there were 65.8 miles of haul-road in the District (table 2).

The average amount of disturbed area per mile of road in clay mining was 32 acres; in coal mining the comparable figure was 106 acres. The difference comes about from differences in the size and tempo of the operations. Clay pits generally are small, their production is relatively low, and many of them are worked only intermittently because of fluctuating demand. Most coal strippings, in contrast, are much larger in both acreage and tonnage extracted, all recoverable mineral usually is removed in one

Table 2.—*Land disturbance attributed to haul-roads*

County	Clay mining		Coal mining		Total	
	Acres	*Miles*	*Acres*	*Miles*	*Acres*	*Miles*
Boyd	—	—	59	15.5	59	15.5
Carter	53	13.9	61	16.1	114	30.0
Greenup	61	16.1	8	2.1	69	18.2
Lawrence	—	—	8	2.1	8	2.1
Total	114	30.0	136	35.8	250	65.8

operation, and one haul-road may serve a comparatively large working area.

We recognized three classes of haul-roads in the overall survey: primary—running from a public road to the mine; secondary—joining two pits or serving as spurs for primary roads; and third class—service roads and temporary haul-roads. In the Princess District about 75 percent of all haul-roads for both coal and clay mining were classed as primary and about 25 percent as secondary; no roads here were listed as third class.

About 90 percent of the roads were on slopes or ridges away from natural drainages and 10 percent were in valley bottoms. Eighty-five percent of the roads ran through forested land; the other 15 percent adjoined land used for agriculture or other purposes.

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